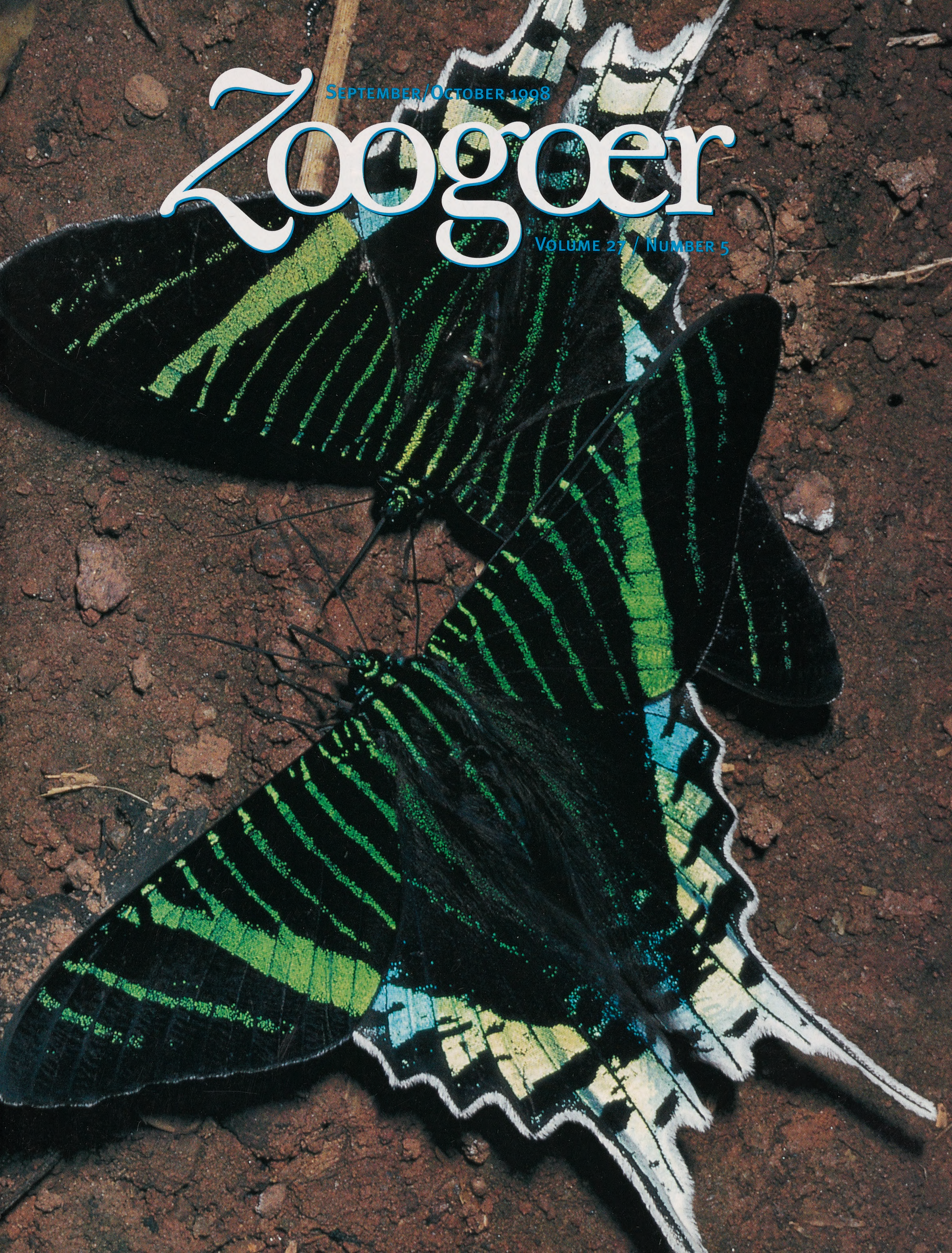


SEPTEMBER/OCTOBER 1998

# Zoogoer

VOLUME 27 / NUMBER 5







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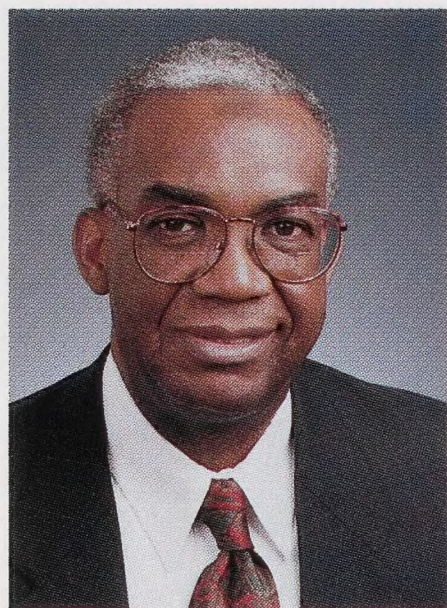
Deepwater sculpins resurface; fungus suffocates amphibians; coyotes colonize the mid-Atlantic region; end of the road for mayflies; attempting to name the aye-aye.





## FORTY WILD YEARS

On October 9, Friends of the National Zoo will celebrate its 40th anniversary. For 40 years, our community-based organization has supported the National Zoological Park, helping to make the Zoo the marvelous institution it is today.



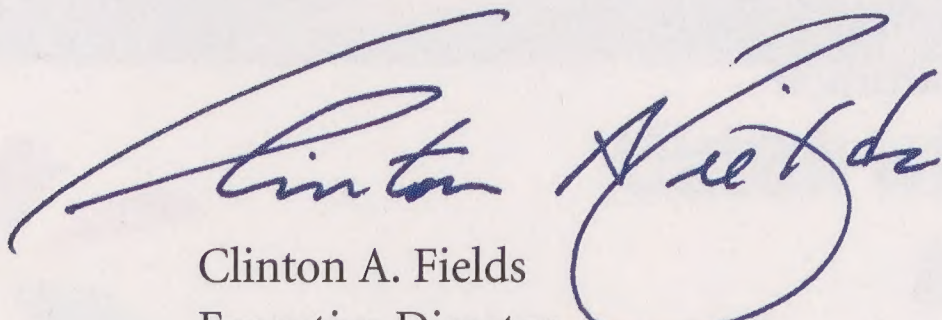
FONZ was founded in 1958 to help solve a serious problem: The Zoo was in need of extensive renovation, and several buildings were closed, awaiting funds for repair. While part of, and managed by, the Smithsonian Institution, the Zoo suffered from an anomalous arrangement in which it received part of its support directly from Congress and part from a District of Columbia appropriation. With each side seeing the Zoo as the other's responsibility, the Zoo was perpetually short of funds. The concerned local citizens who formed what would become Friends of the National Zoo worked to change this. Their mission was to help persuade the Smithsonian and Congress to assume full responsibility for the Zoo. When that mission was accomplished, FONZ looked for other ways to help the Zoo.

Now, 40 years later, FONZ has evolved to be integral to the Zoo's success, and looks to play an even larger support role in the future. Most exciting to me is our growing involvement in carrying out the Zoo's education mission through supporting the completion of new exhibits; interpreting exhibits to the public; producing educational special events; creating curriculum guides for school teachers; and offering classes and workshops for children and adults. FONZ is committed to ensuring that everyone who visits the Zoo goes away with a greater understanding and appreciation of wildlife and their role in the natural world. Moreover, we work to attract people to the Zoo, to develop new audiences for the Zoo's important conservation messages.

Despite FONZ's phenomenal growth during the last 40 years, we remain an organization rooted in the community we serve, because it is the community—you and all of our members and supporters—who serves us. In making friends for the Zoo, FONZ has also made friends, without whom we would not exist.

Please plan to join in the celebration of FONZ's 40th anniversary at the Annual Meeting on Friday evening, October 9. This is not a party for an abstract organization, a set of by-laws and articles of association. This is a party for you: the people who are Friends of the National Zoo. Whether you've been a member for one year or 40, come enjoy your anniversary.

Sincerely,

  
Clinton A. Fields  
Executive Director



is a nonprofit organization of individuals, families, and organizations who are interested in helping to maintain the status of the National Zoological Park as one of the world's

great zoos, to foster its use for education, research, and recreation, to increase and improve its facilities and collections, and to advance the welfare of its animals.

**ZooGoer** [ISSN 0163-416X] is published bimonthly by Friends of the National Zoo (offices located at the National Zoological Park, 3001 Connecticut Ave., N.W., Washington, DC 20008-2537) to promote its aims and programs, and to provide information about FONZ activities to its members, volunteers, and others interested in the purposes of FONZ. Periodicals postage paid at Washington, D.C. Postmaster: Send change of address to *ZooGoer*, Friends of the National Zoo, National Zoological Park, 3001 Connecticut Ave., N.W., Washington, DC 20008-2537. Copyright 1998. All rights reserved.

**The National Zoological Park** is located at 3001 Connecticut Ave., N.W., Washington, DC 20008-2537. Weather permitting, the Zoo is open every day except December 25. Hours: From May 1 to September 15, grounds are open from 6 a.m. to 8 p.m.; buildings, 10 a.m. to 6 p.m. From September 16 to April 30, grounds are open from 6 a.m. to 6 p.m.; buildings, 10 a.m. to 4:30 p.m. **Director:** Michael H. Robinson.

**Membership** in FONZ offers many benefits: publications, discounts on shopping, programs, and events, free parking, and invitations to special programs and activities to make zoogoing more enjoyable and educational. To join, write FONZ Membership, National Zoological Park, Washington, DC 20008, or call 202.673.4961.

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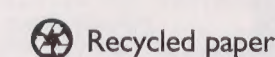
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**Consulting Editor:** Robert Hoage  
**Copy Editor:** Jean B. McConville  
**Design:** Lloyd Greenberg Design  
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Cover: *Day-flying Moths (Urania leila)* by E.S. Ross







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## NOTES & NEWS

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### Special Thanks

Friends of the National Zoo is grateful to the following sponsors for their generous support of the 1998 Wildlife Art Festival. Your continued patronage of these businesses may ensure their future support of FONZ.

We'd also like to thank The Capital Hilton, Embassy Suites, and Omni Shoreham Hotel for providing accommodations for our artists.

### Fall Events for Members

Catch up on FONZ progress in 1998 and look ahead at what next year has in store at the FONZ Annual Meeting on Friday, October 9, from 6 p.m. to 10 p.m. Then snap on your flashlight for the annual Zoo-by-Night tour. Please call 202.673.4961 for more information.

CRC Safari Club members are invited to explore the facilities and grounds at the Zoo's Conservation and Research Center on September 26 and October 3 from 10 a.m. to 3:30 p.m. Guided-tour highlights include red pandas, clouded leopards, and maned wolves. In addition to the tour, there will be interactive displays, crafts for kids, and a buffet lunch. Reserve your spot early; tickets are \$10 for adults and \$8 for children under 12. Please call 202.673.4961 for more information about the tours and joining the CRC Safari Club.

Boo! Celebrate Halloween at the Zoo from 9:30 a.m. until noon on October 24. Costumed grem-lins are invited to parade around the Zoo and stop by the Australia Pavilion for tricks and treats. Throughout the morning, Flumpa, the oversized, energetic green tree frog, and his friends will entertain. Space is limited, so get your tickets soon. Tickets are \$10

for children, and two adults per family are admitted for free.

### Zoo Lecture Series

*October 1*

Cory J. Meacham, award-winning journalist and author, will discuss his latest book, *How the Tiger Lost its Stripes: An Exploration into the Endangerment of a Species*. "The tiger is in no danger of extinction." With that surprising claim, Meacham opens a new and sometimes unsettling exploration into the fate of one of the world's most recognizable animals. Tigers are among the very first animals named in every discussion of "endangered species," and, indeed, there is ample cause for concern. In his presentation, Meacham will discuss what he learned during his 100,000-mile trek through more than one dozen countries to conduct research for his book.

*October 15*

Katy Payne, a bioacoustics researcher at Cornell University, will sign copies of her new book, *Silent Thunder: In the Presence of Elephants*, and discuss her discovery of the complex infrasound communication of elephants and the politics of wildlife. Standing near an elephant in an American zoo, she noticed a vibrating sensation in the air. Payne began recording elephants and, by playing back the "vibration" at fast speed, she discovered a hidden world of communication among these huge mammals, extensive and animated conversation below the range of human hearing. Her research, which continued in Kenya, Zimbabwe, and Namibia, determined that this low-frequency communication is another facet of the complex social interac-

tions of elephants that allows herds to be in contact over vast distances as they search for water, food, and each other.

Booksignings begin at 7 p.m., lectures at 8 p.m., in the Zoo's Visitor Center. For announcements on the latest lectures, send an email to [nzpem053@sivm.si.edu](mailto:nzpem053@sivm.si.edu) or call 202.673.4801.

### Big Foot Art

Ambika, the elephant-turned-artist, has created artful masterpieces now on sale for \$20 at the Department of Education and Volunteer Service (DEVS) office in the Visitor Center. Using her foot as a paintbrush, she has stamped her colorful footprint on paper. Checks should be payable to Friends of the National Zoo. Proceeds benefit the Kumari Elephant Conservation Fund, which supports elephant research at the National Zoo. Call Caroline at 202.673.4955 for more information.

### Animal News

Mohan, a 29-year-old greater one-horned Asian rhinoceros, arrived at the Zoo on June 16 from the Miami Metro Zoo. Mohan is easily distinguished from Mechi, the Zoo's 12-year-old female rhino, by the blond hair lining his ears. Because the 5,000-pound male hasn't fathered offspring, he makes an ideal mate for Mechi. The Zoo's recent efforts in the Species Survival Program resulted in the birth of two rhinos in 1996. Due to poaching and habitat destruction, only 2,000 greater one-horned Asian rhinoceroses survive in the wild.

In early May, a new female sloth bear, Hana, arrived on loan from the Toledo Zoo, bringing the Zoo's



sloth bear population to one female and two males. Hana, born in Poland in December 1994, will add genetic diversity to the North American zoo population if she can produce offspring with one of the males here. The Zoo's effort to breed endangered sloth bears is part of the Species Survival Program. Sloth bears, which are native to India and Sri Lanka, are known for their curved claws and long, flexible snouts.

Twin Geoffroy marmosets were born at the Small Mammal House on July 2. The parents, which have now produced a total of seven offspring, are very attentive, grooming and feeding the young diligently.

Both the mother and father alternate carrying the



twins, which gives each parent a chance to rest. When people approach the exhibit, the mother demonstrates another sign of good parenting by staying nearby her twins to protect them.

Seven fluffy, gray flamingo chicks are slowly being introduced to the flamingo yard. For protection from elders, the chicks will first live in their own fenced-in area of the yard. As the chicks grow bigger, the fence will be removed. Because so many are being raised at once, the birds should be well-socialized.

In the past, Inca terns have not taken to breeding in the Outdoor Flight Exhibit, but thanks to keeper ingenuity, four Inca tern chicks are thriving this season. PVC piping provides a very secure nestbox and a new food combination offers great nutrition. Visitors may be able to spot the nests hidden

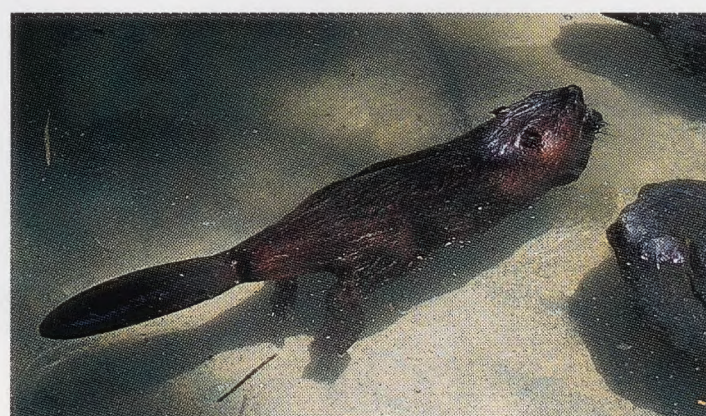
among dead branches at the base of the white support pole in the center of the exhibit.

On July 3, a Micronesian kingfisher chick hatched. Because the chick fell from its nest in the Micronesian kingfisher exhibit, it is being raised by keepers. The species, now extinct on Guam, is part of the Species Survival Program, but zoo breeding has only been moderately successful.

Granby, a one-year-old female North American beaver from



Quebec's Granby Zoo, went on exhibit on June 9. Although the Zoo's male, Cleaver, greeted Granby with aggression in the first 24 hours, the two seem to be getting along well now. "It was not love at first sight," said keeper Linda Moore. If the two produce offspring, it will be the first time beavers have bred at the Zoo.

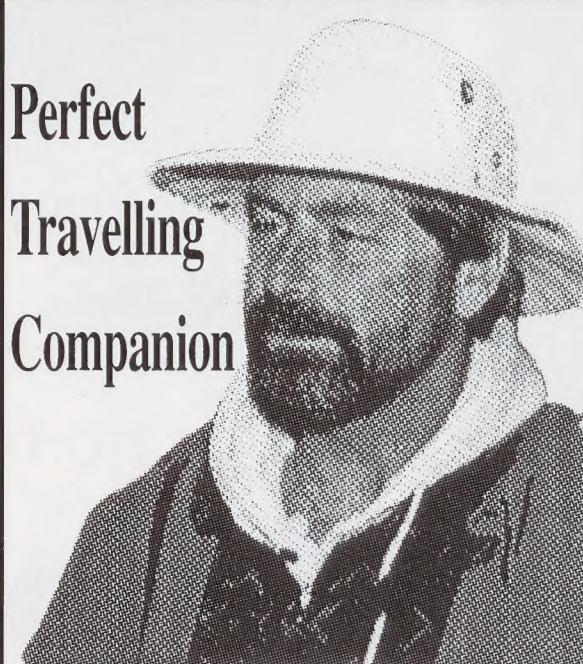


Queen butterflies and monarchs join orange julias and zebra long wings in the Invertebrate Exhibit's Pollinarium. Monarchs, known for their long migrations, can fly up to 2,000 miles between North and South America. Queen butterflies, characterized by two large white spots on their brown wings, hold the record for butterfly mating; females can mate up to 15 times. Orange julias are fast fliers from the southeast U.S., while zebra long wings are slow, graceful fliers from the south and midwest U.S.

Photos by Jessie Cohen.

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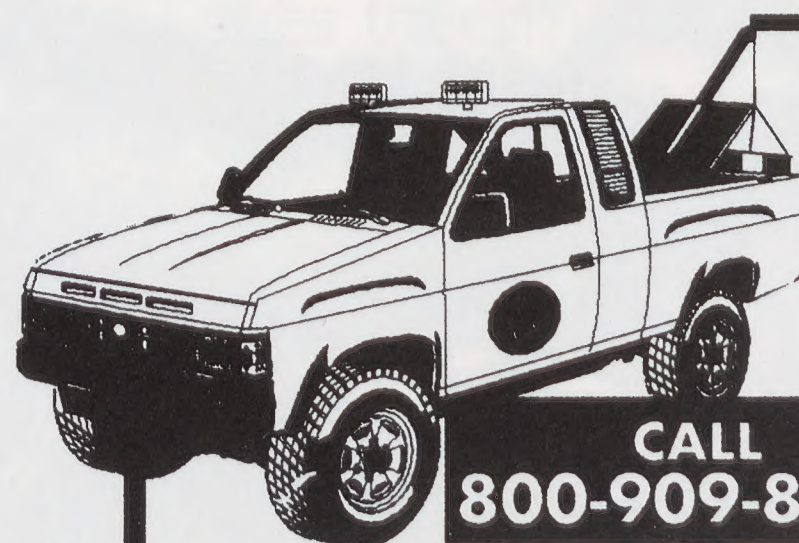
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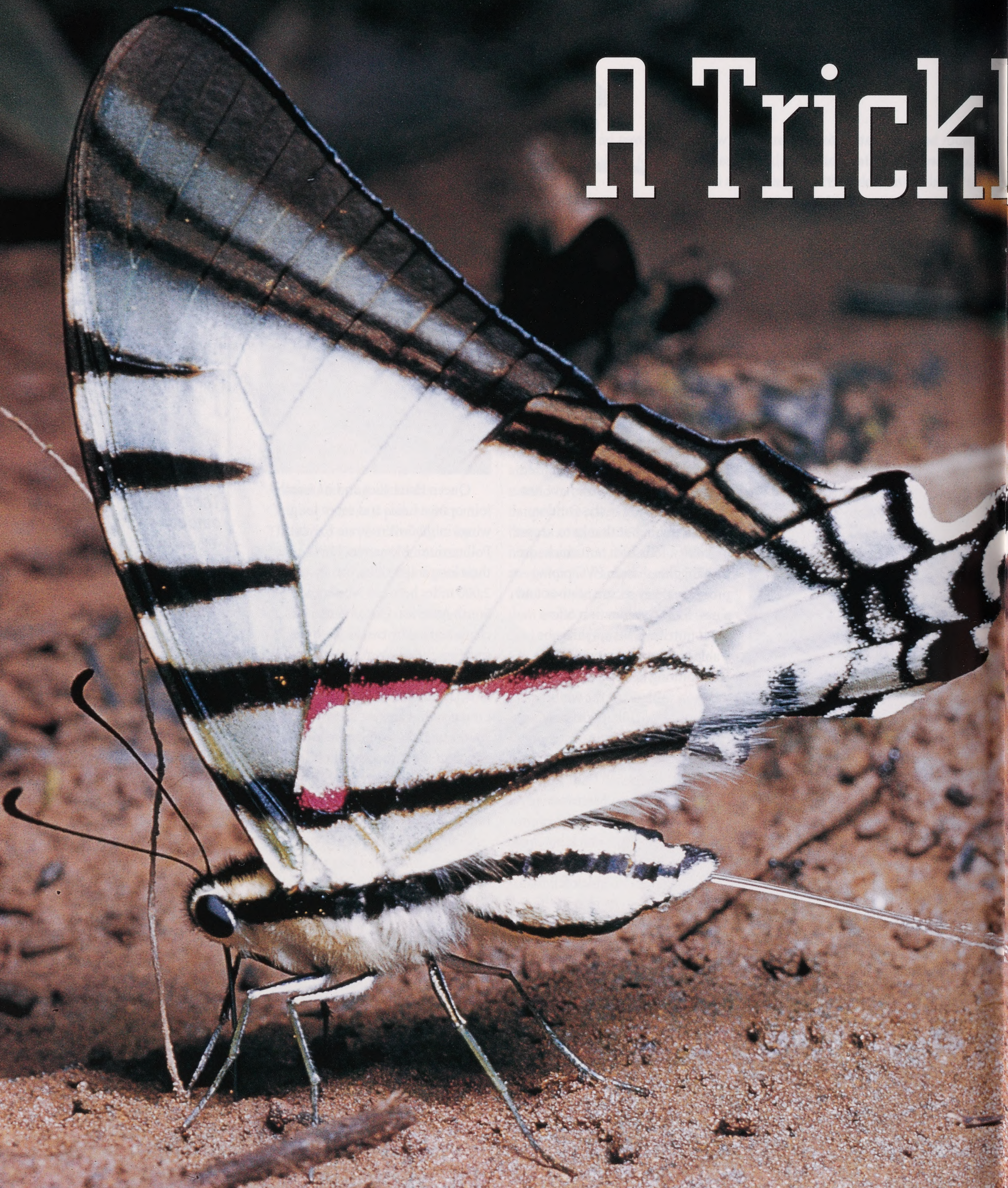
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# A Trick





# e-down

# Forest

LEFT: IN THE AMAZON RAINFOREST, THIS SWALLOWTAIL (*PAPILIO AGESILAUS*) SQUIRTS WASTE WATER AS IT SUCKS SALT FROM URINE-SOAKED SOIL.

RIGHT: A FEMALE EUTHALIA FEASTS ON FRUIT IN SINGAPORE.

Text and Photos  
BY  
Edward S. Ross



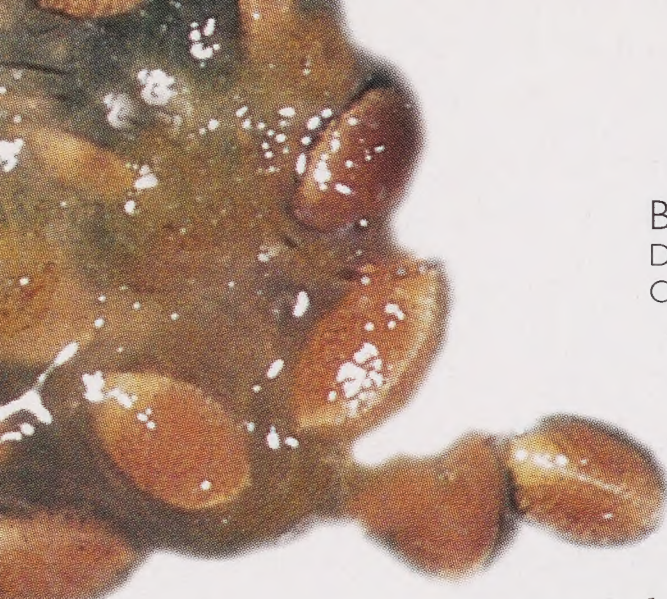
A chattering and crashing of guenon monkeys in branches directly overhead—a sudden swish—a near miss! I was almost hit by a most unpleasant bomb—a monkey dropping. The fecal attack might have been deliberate—perhaps a normal defensive tactic in the world of primates. Adrian Forsyth, in *Portraits of the Rainforest*, amusingly noted that howler monkeys have a “bombs-away” attitude to this event, and they are not averse to anointing naturalists and other interlopers with their copious and pungent waste products. They are often quite good at targeting, and the combination of height and gravity gives their messages an impact that cannot be ignored.

# Economy



SCARAB BEETLES LOCATE DROPPINGS IN THE AMAZON WITH CHEMICAL-SENSITIVE ANTENNAE. THEY ROLL EXCRETA INTO BALLS AND FEED ONE BALL TO EACH OF THEIR LARVA.





BELOW: CRAB SPIDERS IN THE AMAZON RESEMBLE BIRD DROPPINGS TO AVOID PREDATORS, AS WELL AS TO PREY ON INSECTS SEEKING NUTRITION FROM REAL EXCRETA.

The next morning in that Congo forest, I returned to the scene of the presumed bombing attack and much to my delight as an entomologist, I found the excrement crowded with colorful butterflies of at least 15 species, including those that normally fly high in the canopy. Joined by the other insects, they were bloating on fecal juices. Beneath the pile, scarab beetles were rapidly burying portions in the soil as provisions for their future larvae.

This activity reinforced my awareness of the nutritional importance to many insects of animal excreta and partially eaten fruit and prey that fall from a forest's upper levels. In addition to such tidbits, all forests, both tropical and temperate, are primarily fed by another kind of "excrement"—a rain of soon-to-rot dead leaves, branches, and fruit. In deciduous, temperate forests, like those in the Washington metropolitan area, the drop is mostly seasonal, initiating a winter shutdown of the biotic factory. Because of winter's cold and consequent long dormancy, there accumulates an ever-increasing amount of humus that ensures continued

and animals shortly after it reaches the ground. Very little accumulates; it is truly a hand-to-mouth bioeconomy. Thus, most of the tropical forest's life—its biomass—is above ground whereas that of a temperate forest is both above and below ground. This, of course, explains why rainforest soils, unless volcanic in origin, are too poor



for sustained agricultural use and the forests are best left undisturbed.

As an entomologist, I especially appreciate tropical forests with a rich fauna of canopy vertebrates, particularly many birds. This is because of the large numbers and diversity of ground- and shrub-level insects that depend, for at least a part of their diet, on excreta falling from a forest's upper levels. It follows, therefore, that the larger and more diverse the vertebrate fauna are, the richer and better fed many elements of the insect fauna will be.

Especially noticeable are insects, often in multi-species assemblages, feeding on juices of bird droppings. At least in the case of butterflies and day-flying moths, the attraction isn't always food per se but, instead, dietary-enriching chemicals such as calcium and salt, which are in short supply in tropical forests due to leaching by heavy rainfall. Thus, in a sense, bird droppings function like the salt licks frequented by mammals in Africa. After a day of sweating in a humid forest, a visitor soon notes that he or she too has become a salt lick, with bolder insects imbibing salty

perspiration on the skin and increasingly rancid clothing. Skipper butterflies are especially attracted to bird droppings. These must primarily be visually detected, for swift, big-eyed skippers rapidly check anything white, even a fallen flower petal. When there is a scarcity of bird droppings, some skipper collectors bait leaf surfaces

with guano-like pieces of tissue moistened with saliva. The saliva serves both as an adhesive and a dietary reward for the skipper, particularly if a collector has made it more attractive by sucking hard candy. Many other kinds of butterflies and insects are also attracted to such lures. Most often, however, recognition of attractive detritus is by smell, not sight. I never cease to marvel at the sight of one or more insects feeding on a scarcely discernible caterpillar dropping, or the shriveled remains of a minute insect dropped by a bird. A faint column of odor rising from such bits appears to be detected by the many chemoreceptors, or sensillae, on antennae. The receptive insect then circles down and finally locates the morsel by sight. Very often other insects have already alighted on or near it, and their presence may lure even more insects.

Aside from these food sources, the most sought after and available nourishment for forest butterflies and other small creatures is not flower nectar, but fermenting fruit and sap oozing from stems and tree trunks. In the dark gloom at a rainforest's ground level there are relatively few "insect flowers," that is, those colored to attract insects and shaped for their convenience, such as the daisy, which offers the insect a place to land. Most flowers within tropical forests are shades of red or orange that lure bird visitors, such as hummingbirds, during day-



ITHOMIINE BUTTERFLIES OF TROPICAL AMERICA RELY ON FALLEN FRUIT AND BIRD DROPPINGS FOR NUTRITION.



THESE AMOROUS LONG-HORNED BEETLES (*ONYCHOCERUS CRASSUS*) AVOID PREDATOR INTEREST BY RESEMBLING BIRD DROPPINGS.

soil fertility long after an area is deforested.

In contrast, lowland, continuously wet tropical forests produce day and night, season after season, and many haven't shut down for millennia. In portions of the Amazon Basin, for example, the production has been constant for perhaps 100 million years or more. Thus there has been time, warmth, moisture, and space for the evolution of a mind-boggling, seemingly impossible complex of species, especially of plants and insects. As the late Marston Bates so aptly stated, "almost anything can survive [in a tropical forest] and almost everything does."

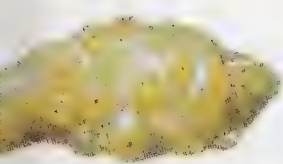
Unlike in temperate forests, however, detritus in tropical forests is consumed by plants



BUTTERFLIES AND OTHER INSECTS IN THE AMAZON OFTEN CONGREGATE ON A FOOD ITEM.



BUTTERFLIES OF AT LEAST 15 SPECIES JOSTLE FOR JUICES OF A GUENON MONKEY DROPPING IN THE CONGO RAINFOREST.



light hours. Many other flowers are white, often fragrant, and attract other pollinators, like long-tongued moths and bats, at night. Both types of flowers may secrete nectar in the depths of tubular corollas that can be secured only with a long tongue or proboscis during flight, or by “nectar thieves” that pierce corolla bases to steal nectar.

The adult activity of most butterflies is fueled by flower nectar. Egg production, however, is dependent on food reserves accumulated during the caterpillar stage. No eggs can be laid once those reserves are gone. Research by Thomas S. Ray and Catherine C. Andrews in Costa Rica, however, indicates that female ithomiine butterflies (a subfamily of Nymphalidae characteristic of New World tropics) can lengthen their reproductive life from a few weeks to at least four months by securing uric acid or partially digested proteins from the droppings. Frequent use of droppings as a



To my delight as an entomologist,  
I found the excrement crowded with colorful butterflies of  
at least 15 species bloating on fecal juices.

dependable food supplement enables the butterflies to produce numerous egg clusters, perhaps throughout their lives. Because the droppings must be fresh, it is strategic for female ithomiines and other butterflies to frequent forest areas with an abundance of antbirds (family Formicariidae). Such birds fly above advancing hordes of army ants so as to feed on the insects the ants flush out of leaf litter and off low-growing plants. Researchers Ray and Andrews speculated that the butterflies locate bird concentrations by detecting the distinctive odor of masses of the ants.



Normally, birds are the primary predators of butterflies. Most ithomiines, however, have little to fear because the majority of adults, especially males, are likely to have ingested poisonous fluids (pyrrolizidine alkaloids) present in or on flowers and foliage surfaces of the very common plants of the tribe Eupatorieae of the daisy family. Thereby most have become distasteful, or even poisonous, to birds and other predators. This acquired repugnance is advertised by dis-

tinctive, interspecific warning colorations that are often mimicked by palatable, unrelated species. Adult ithomiines experimentally reared without access to poisonous plant secretions, including those of decomposing foliage of boraginaceous plants, are palatable. Most other unpalatable insects sequester protective toxins by ingesting during their larval stages foliage or sap of poisonous plants, such as *Solanum* (nightshades, including tomatoes and potatoes), milkweeds, *Aristolochia* (Dutchman's pipe), and *Passiflora* (passion vines).

Vertebrate predators don't feed on excrement so a resemblance to such repugnant inedibles is a very common defense of many small creatures, such as some beetles, caterpillars, moths, spiders, and even frogs. Appropriately, as in so many other cases of object-resemblance, excreta-like creatures are adapted to remain immobile during the day with activity confined to the dark of night when most predators are inactive.

A curious twist occurs, however, when a bird-dropping resemblance

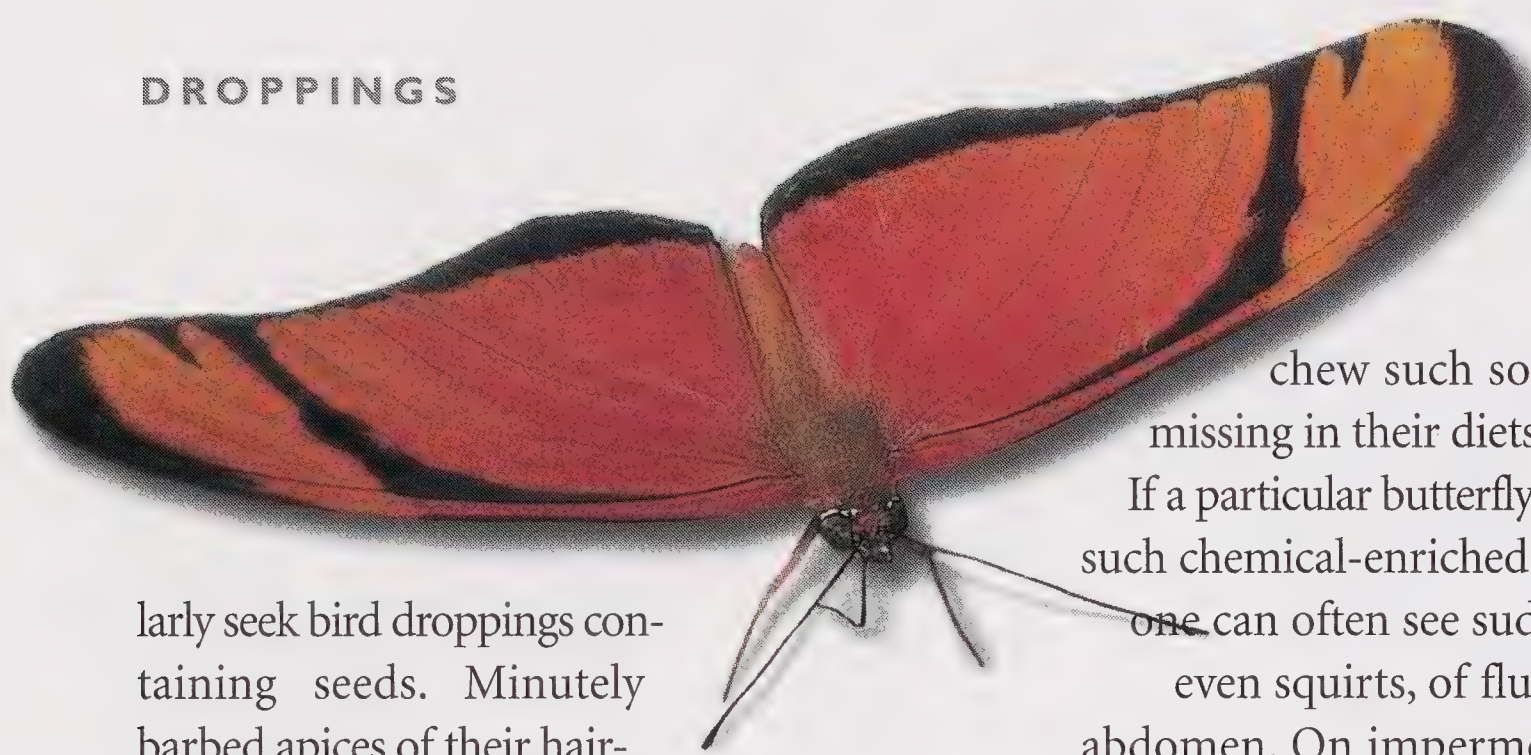
not only serves as a defense but also as bait to attract prey. A remarkable crab spider in southeastern Asia not only appears to be a bird dropping, but also spins a white, flat web on a leaf surface that resembles splashed excrement. It then waits with trap-like fangs ready to snatch any salt-seeking insect that alights within reach. In this way, free-roaming white crab spiders may simply sit about fully exposed on leaves, luring insect prey without attracting the interest of vertebrate predators. Once I saw a fast-flying orchid bee (*Euglossa*), intent on getting nutrients from a real bird dropping, quickly caught and paralyzed as it alighted on such a spider. There also are pure white nymphs of assassin bugs (*Reduviidae*) that sit about for hours fully exposed with sticky forelegs widespread, ready to snatch fooled, nutrient-seeking insects.

Excrement is often mentioned as an important means of seed dispersal and this, too, can have interesting entomological aspects. True bugs (order Hemiptera), especially of the families Alydidae and Lygaeidae, regu-





## DROPPINGS



INSECTS, ESPECIALLY BOLD BUTTERFLIES, FIND SWEAT-SOAKED SKIN AND CLOTHING A RICH SOURCE OF SALT.

larly seek bird droppings containing seeds. Minutely barbed apices of their hair-like mandibles cut through seed shells and then macerate the contents while the bug injects salivary digestive enzymes that liquefy the solids so it can suck the predigested food. (Hemiptera subsist only on liquid food.) Because pre-oral digestion is a prolonged process that occurs while a bug is fully exposed to view on a leaf surface, the bugs reduce predation by mimicking ants, both in appearance and behavior—many predators avoid ants because they may sting, bite, or swarm their attackers.

Less subject to predation are tiny lygaeid bugs, *Oligenes subcavicola*, which form a great crawling mass, estimated at 400,000 bugs per square meter, on the floors of Neotropical caves. They subsist on billions of tiny seeds excreted by fruit-eating bats clinging to the ceilings of the caves.

At times attraction to a particular site isn't due to animal excreta but instead to seepage of calcium and other useful chemicals inorganic in origin. A high clay river bank, a *colpa*, along Peru's Rio Manu that attracts a multitude of parrots, including five species of macaws, is a famous example. It has been concluded that the birds obtain chemical antidotes to overcome toxins present in some of the fruits they eat. Dry season chemical concentrates on exposed bottoms and beaches of receding streams also can be very attractive to insect drinkers, especially if the stream has picked up salts while eroding upstream geological formations containing such chemicals. Primates, including humans, often

chew such soil to obtain chemicals missing in their diets.

If a particular butterfly or moth drinking from such chemical-enriched soil is closely watched, one can often see sudden, regular ejections, even squirts, of fluid from the end of the abdomen. On impermeable surfaces, a small puddle may develop under the drinker. Obviously, fluid ejection results from a need to pass great quantities of soil moisture through the gut in order to extract a sufficiency of useful, but dilute, chemicals.

Sometimes a "puddle club," as they are called, can be quite amusing. In Brazil, I encountered a tandem line of three skippers on the ground, each rapidly squirting excess fluid from its anus. The second and third to the rear were in direct line to receive the full force of the squirts in their "faces," yet they didn't move, even as liquid droplets piled up on their heads and bodies! Even better was a riordinid butterfly I observed sucking fluid from a bird dropping in an Amazonian forest. After a series of anal ejections it turned around and sucked up its own excrement!

Commercial butterfly collectors in Taiwan speed the accumulation of marketable specimens by pinning dead, damaged, or even paper butterflies, to urine-baited soil. Sometimes, near a tropical village, especially when a river bank is used as a latrine or a laundry, spectacu-

lar assemblages of butterflies may gather on the sand or mud, especially if the day is sunny. Curiously, butterflies often group within the multitude according to color and species. They fly up like confetti when disturbed and this might confuse a predator. Experienced entomologists hold their own urine for release where it will serve as bait on surfaces most convenient for collecting or photographing insects. Unless leached by rain, these sites will increasingly appeal to insects for several days as the urine ages.

Another trick is to concoct horrible, but ef-

## The attraction isn't always for dietary-enriching chemicals such as sweat which are in short supply

fective, baits by mixing various ingredients such as stale beer, urine, fermenting fruit, and feces. After a period of "ripening," dabs of the disgusting gunk are placed here and there on various surfaces. Such bait would seem to be artificial, but most of its basic elements are highly nutritious. Most adult insects, in contrast to the specialized diet of their larvae, have rather broad tastes and are drawn to many strange foods, such as moist ashes, carrion, human saliva, eye secretions of turtles and mammals, aphid honeydew, sweet secretions of certain caterpillars, and fresh and putrefying fish. While I camped in Madagascar, great numbers of butterflies fed on our catsup. Interestingly, freshly emerged male butterflies are more attracted to such strange foods than are females.



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Currently, most of my observations of insect behavior occur along trails in a large primeval forest reserve maintained by Butterfly Lodge (Cabanas Alinahui) on the upper Rio Napo of Amazonian Ecuador. Although more than 500 species of birds occur in the forest, their presence is more evident from their sounds and excreta than from actual sightings. Nevertheless, forest visitors are amply rewarded by first-time encounters with small creatures, especially beautiful butterflies, which so often concentrate on animal droppings and other detritus.

In spite of all this richness, I often think of how much more could be seen if the large mammal and bird fauna had not been shot out by local Indian and colonist hunters. The most significant loss has been monkeys,

od per se but, instead, such as calcium and salt, in tropical forests.

a favorite, easily hunted food—one almost a required entree on festive occasions such as weddings. Now, with monkeys so rare, I would willingly endure a “rain,” or a delibera

bombing, of monkey feces, to be able to encounter an increase in excrement-dependent insects. What an experience it might have been to have seen tropical forests, or any other habitats for that matter, before that relatively recently evolved scourge—*Homo sapiens*—appeared on Earth’s scene.

Urgently, we must pay our debt to societies of plants and animals by supporting efforts to preserve and restore as many of Earth’s biomes as possible to serve as Louvres of Life, regulators of climates, watersheds, and sources of valuable products—some yet to be discovered. Not the least, such preservation will ensure that future generations of humans will be able to enjoy continued performances of ancient, life-enriching biodramas, each with its well-rehearsed cast of players, dramatically performed on Earth’s most lavishly decorated stage—the tropical rainforest. Z

**Edward S. Ross** is Curator Emeritus at the Department of Entomology at the California Academy of Sciences.

For more information about the Butterfly Lodge, phone 415.383.6130.



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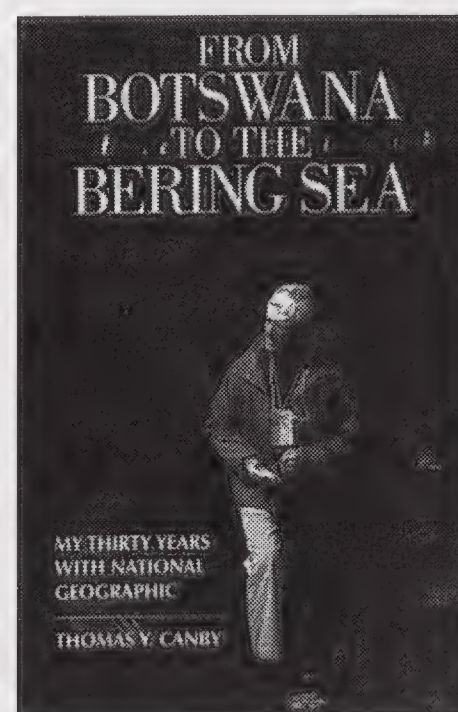


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Growing as fast as one foot in a single day, kudzu can completely overgrow native vegetation, strangling and pulling down trees in its path.



# invasion

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By Robin Meadows



If you're like me, peaches make you think of Georgia, bluegrass of Kentucky, and tumbleweeds of western rangelands. These plants evoke particular regions of the country so strongly that you might be surprised to hear that they—and many of the other plants growing around us—are not native. Queen Anne's lace, common daylilies, dandelions, and multiflora roses, among the commonest of wildflowers, also hail from abroad.





**HYDRILLA:** Native to Asia, Africa, and Australia, this feathery aquatic plant was introduced to Florida's waters in the 1950s by the aquarium trade. Hydrilla can grow ten inches a day, forming thick, green mats that choke lakes and rivers.

Hydrilla infests the southern tier

of states from Maryland to California and tolerates so many conditions that it could easily spread throughout most of the U.S. and Canada.

In fact, more than one tenth of the 19,000-odd species of plants established in the U.S. come from other countries. Most of these introduced plants are benign or even beneficial. But some non-native species flourish spectacularly in the absence of the predators and diseases that keep them in check in their native lands. These alien plants are invading our wildlands and crowding out native species. The severity of the problem has only recently been recognized by ecologists and remains to be taken seriously by most policy makers. But there are signs that the Administration may push for a national policy to control invasive alien species.

Although non-native plants infest more than 100 million acres of public wildlands nationwide, most people are unaware of the problem. One reason is that plant invasions can take decades. This relatively slow pace doesn't mean we can be complacent: Each day an estimated 5,000 additional acres are lost to invasive non-native plants. Another reason that plant invasions escape notice is that they are not obvious to the untrained eye. After all, introduced plants can be just as luxuriantly green and inviting as the native species they have overgrown.

But even though plant invasions aren't as dramatic as toxic chemical spills, the ecological effects can be just as devastating. "Leading ecologists now consider invasive species to be the

*Bioscience* found that alien species, both plants and animals, were a threat to 49 percent of all species in the U.S. that are currently at some risk of extinction.

By displacing native plants, alien species can also displace the animals that depend on particular plants for food and shelter. Invasive alien plants can take areas over completely, establishing biologically sterile mono-cultures where nothing else grows and few animal species can live. In the worst cases, invasive plants transform ecosystems, turning, say, grasslands into woodlands. This ability to fundamentally alter ecosystems generally makes invasive plants a greater environmental threat than invasive animals.

Invasive alien plants also threaten agriculture and cost an estimated \$13.5 billion each year in lost production and control efforts, according to the Weed Science Society of America. Weeds reduce yields by outcompeting or contaminating crops, and reduce livestock production by displacing forage on rangelands. For example, once established, an unpalatable European weed called leafy spurge can completely replace native grasses in just a few years.

People have been introducing plants outside their native ranges for

thousands of years. Many of the non-native plants established in the U.S. were brought by explorers, missionaries, and early settlers. Some were brought intentionally. For instance, white clover and annual rye grass were introduced to provide forage for cattle, horses, and other introduced domestic livestock. Other plants

# When alien species take regional differences Some ecologists call species "McD

were brought by mistake, say as contaminants in seed. Accidental introductions include nettles and crabgrass, plants that are generally recognized as weeds by all. But any non-native plant, no matter how useful or beautiful, is considered to be a weed if it's growing where it doesn't belong.

More recently, one of the principal sources of non-native plants in the country has been the USDA's Agricultural Research Service, according to the book *Strangers in Paradise*, edited by Daniel Simberloff of the University of Tennessee and Don Schmitz and Tom Brown, both of the



Florida Department of Environmental Protection (Island Press, 1997). The USDA began international expeditions to collect plants for agriculture, soil conservation, and gardens in 1897. While the expeditions' initial focus was on forage and grain crops, by the 1930s their primary goal was collecting ornamentals, say Simberloff and his co-authors. By 1967 the USDA had made more than 300,000 shipments of alien plants into the country—an average of more than 4,000 shipments each year.

Most of these introduced plants have stayed where they were planted but some have not been so well-behaved. Probably the most infamous plant introduction is kudzu, a Chinese native that the USDA's Westbrooks calls the vine that ate the South. During the 1930s and '40s, the U.S. Soil Conservation Service (now the USDA Natural Resource Conservation Service) distributed about 85 million kudzu seedlings to southern landowners in part to control erosion along roads and other disturbed sites. Growing as fast as a foot in a single day, kudzu can completely overgrow native vegetation, strangling and

**CHINESE TALLOW:** Prized for its yellow-to-red fall foliage, this fast-growing east Asian tree was introduced to South Carolina in the late 1700s. Chinese tallow is known as the "happy invader" because it thrives under a range of conditions from full

sun to shade, and soil that is wet, dry, or even salty. This tree has spread from South Carolina to Florida and along the Gulf Coast to Texas, where it has changed much of the coastal prairie into woodland. Chinese tallow is still sold in the U.S.





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in flora and fauna.  
the global spread of  
onalization.”

pulling down trees in its path. Today kudzu infests more than seven million acres from New Jersey to Texas and is spreading by 125,000 acres each year. “Control costs and losses due to this one weed are now over \$450 million per year,” says Westbrook.

Despite this long history of plant introductions, as recently as ten years ago most ecologists thought that invasive alien plants were nothing much to worry about. The theory was that disturbed habitats were the most susceptible to invasion because they had already lost much of their native vegetation. Pristine habitats, which



JOHN RANDALL / THE NATURE CONSERVANCY

were still rich in native plants, were thought to be relatively resistant to invasion. But studies have shown that this theory of “biotic resistance” is too simplistic and that alien plants can also invade pristine habitats quite effectively.

While ecologists now know that invasive alien plants are a problem, “the significance of the issue hasn’t gotten the attention of many decision makers and leaders,” says Gary Johnston of the National Park Service (NPS) in Washington, D.C. Efforts to galvanize the government into adopting a national policy to protect agricultural and wildlands from alien species go back to at least 1977, when President Carter issued an Executive Order instructing all federal agencies to restrict the introduction of all non-native species.

But 15 years later the federal government had still done little. At the request of Congress, the now-defunct Office of Technology Assessment (OTA) investigated the status of alien species in the U.S. The OTA found that most federal agencies ignored Carter’s Executive Order due to strong opposition from agriculture, the pet trade, and other special interest groups, according to

its 1993 report *Harmful Non-Indigenous Species in the United States*.

Prompted by the OTA report, in 1994 the federal government formed the Federal Interagency Committee for the Management of Noxious and Exotic Weeds (FICMNEW) to coordinate government efforts.

The committee held a series of weed summits bringing together interests ranging from government agencies and conservation groups to cattlemen and nurserymen. Out of summits came the 1996 National Weed Strategy “Pulling Together,” which identified ways of improving weed control efforts. This summer FICMNEW also published a weed fact book called *Invasive Plants: Changing the Landscape of America*.

While far better than nothing, FICMNEW is not enough. “I applaud their efforts,” says the Florida Department of Environmental Protection’s Don Schmitz. “However, FICMNEW really doesn’t have much clout in terms of asking for funding or even compiling the relevant information.” This includes documenting both which alien species are where, and how well various eradication approaches have worked.

Schmitz had been trying to get the government to address the problem even before the OTA issued its report in 1993. The previous year, he and 25 other nationally respected ecologists sent a letter about the growing threat of alien species to Vice President Gore. “The letter arose out of deep frustration with the present system and the way it has failed,” says Schmitz. “But all I got was a polite ‘don’t call us, we’ll call you’ letter. Gore probably never even saw

#### MELALEUCA:

This Australian tree was introduced to Florida in 1906 as an ornamental and to dry up wetlands in the Everglades. Melaleuca is thought to alter ecosystems by using more water, which lowers the water table, and by burning more readily than native vegetation, which increases the frequency of fire. Melaleuca invasions can change sawgrass marsh into swampy forest. Producing millions of seeds per tree, melaleuca grows in dense stands that cover more than 350,000 acres of the state. While no longer sold in Florida, melaleuca is still available in California.



GREG JUBINSKY

my letter.”

In 1997, Schmitz tried again. His second letter called for a commission to develop a national policy on invasive species and was signed by more than 500 ecologists and land managers, including Daniel Simberloff, who serendipitously had just been appointed to the University of Tennessee at Knoxville’s Nancy Gore Hunger chair that the Vice President had endowed in memory of his sister. In honor of his appointment, Simberloff got to meet with Gore and it just so happened that Schmitz finished collecting all the letter’s signatures just before the meeting. This time Schmitz made sure that Gore saw the letter: Simberloff hand-delivered the letter to the Vice President during their meeting.

This time Schmitz received a response from Gore himself, promising to ask the Departments of Interior, Agriculture, and Commerce to help craft a national strategy for invasive alien species. The resulting ad hoc interagency task force has written a white paper briefing the administration on the problem and has also recommended that President Clinton issue an Executive Order

#### TAMARISK:

Also known as salt cedar, this Eurasian tree was introduced in the West in the 1800s for wood, shade, and erosion control. Tamarisk grows along rivers in the arid southwest, forming dense thickets where riparian woodlands used to grow and decreasing the diversity of birds and small mammals that live there. Tamarisk’s deep roots lower the water table, depriving native plants of water, and the thickets block water channels, causing floods that can wash away native plants. Although concentrated in the southwest, tamarisk is also as far north as Montana and as far east as Virginia. Tamarisk is still sold in the U.S.



DAVID HAGEN



on alien species, says Gordon Brown, the Department of the Interior's invasive alien species coordinator.

Assuming that the task force's recommendations are followed, this Executive Order will have more teeth than Carter's ill-fated effort. Notably, the task force recommends establishing a National Council on Invasive Species to develop and implement a comprehensive plan for managing all types of alien species. Unlike the agencies charged by Carter's Executive Order, this council on invasive species would be accountable both because it would have a deadline for developing the plan and because it would have to write annual reports for the Office of Management and Budget, says Brown.

Tightening the federal policy on alien species is critical. For instance, more than 20 agencies have jurisdiction over some aspect of alien plants, so many that it is no surprise that they are poorly coordinated and sometimes even at cross-purposes. In a classic case of the right hand not knowing what the left is doing, the Florida Department of Environmental Protection eradicates infestations of the aquarium plant water spinach (*Ipomoea aquatica*), which can smother beds of native aquatic plants in rivers and lakes—but water spinach continues to be sold across the state's lines because the USDA's Animal and Plant Health Inspection Service does not have the authority to prohibit the interstate sale of species listed as noxious weeds.

While coordinating government agencies is a good start, far more is needed. "There is more or less unrestricted importation into the country,

no agency is charged with dealing with the problem, there is no national legislation, and there are no control mechanisms," says the NPS's Johnston, who co-chairs FICMNEW.

Ecologists say the most important tactic in the "war on weeds" is keeping invasive species out of the country in the first place. But current regulations don't come close to doing the job. The main way to ban non-native plants is to put them on the federal Noxious Weed List. But getting plants on the list is very difficult: Only 94 types are listed today even though at least 750 species were known to meet the criteria for listing back in 1993, when the OTA issued its report on harmful non-native species.

"The problem with the federal noxious weed list is that it's an all or nothing approach," says Schmitz. "But what might be invasive in Florida probably isn't in Oregon. Hence, it's difficult to convince northern agricultural business interests to agree to ban something that's only invasive in Florida." He suggests making the federal noxious weed list flexible enough to ban plants only in particular regions of the country. Such a proposal is now being reviewed by the USDA, says the USDA's Westbrooks, who is on special assignment as the invasive plant liaison between the Departments of Agriculture and Interior.

A related issue is that of native plants that become invasive when planted outside of their natural habitat. Black locust trees, for instance, are from the southeastern U.S. but have been widely planted throughout the country. In California, black locusts invade canyons and riparian areas, where they spread by root suckers and form

thickets that displace native Californian vegetation. Eastern cordgrass, a sedge native to East Coast salt marshes, has invaded West Coast mudflats. "Eastern cordgrass is a monster problem in California and Washington state, where it is filling in mudflats at a rapid rate," says Simerloff. "They've spent millions of dollars trying to control it."

Besides banning

alien plants that are known invaders, many argue that species likely to become problems in the U.S. should be kept out. The trouble is that there is no sure way of identifying these species ahead of time. Invasive species do tend to have certain characteristics—such as producing many seeds at a young age or having berries that birds eat and disperse—but non-invasive species can also have some of these characteristics. Predicting invasiveness is made even trickier by the fact that there can be long lags between a plant's introduction and invasion. For instance, Japanese honeysuckle was introduced in 1806 but did not escape cultivation and become a serious weed until 1890. Neither the cause of the lags nor the eventual triggers of invasion are understood.

Although not foolproof, some of today's screening methods are still useful. Field trials, for example, can test a plant's behavior in a variety of habitats. But the best predictor of invasiveness is probably whether or not a given plant has become weedy in a similar climate. For example, about 90 percent of Australia's noxious weeds are also invaders elsewhere in the world.

Critics say that screening plants for invasiveness would result in banning lots of harmless species. While admitting that this is true, ecologists counter that without screening, new invasive plants will surely be introduced. "Non-native plants should be guilty until proven innocent," says the University of Tennessee's Simberloff. The Nature Conservancy's John Randall agrees, pointing out that "Australia and New Zealand are doing a lot more than we are. They only let in species on the good list. Here we let in anything but species on the black list, which is very limited. They're really taking it a lot more seriously."

In the absence of mandatory screening, educating the public and nurserymen offers the best chance of slowing down introductions of ornamentals, says Randall. Gardeners love new plants, from the beautiful to the bizarre and everything in between. And nurseries are in the business of meeting their customers' desires. But avoiding invasive ornamentals—many of which are still sold in nurseries—would still leave gardeners thousands of choices, he says.

There is also a promising movement toward voluntary screening among nurserymen. Spurred by the potential for stronger federal weed legislation, a working group to encourage self-regulation has been meeting since 1996. Members of the group include representatives from the nurs-

**PURPLE LOOSESTRIFE:** This European perennial has beautiful spikes of purple flowers and was introduced in New England in the early 1800s. Purple loosestrife thrives in wetlands and stands can reach thousands of acres, covering the open water areas used by aquatic birds. Purple loosestrife is difficult to control because it spreads by producing millions of tiny seeds as well as from stem and root segments. Nicknamed the "purple plague," this plant spread through most of the U.S. While about half the states have banned



JOSEPH G. STRAUCH, JR.

purple loosestrife, it is still sold commercially elsewhere. Some of the varieties sold are supposedly "sterile" but even these can be fertile, according to a 1996 report from The Nature Conservancy called "America's Least Wanted: Alien Species Invasions of U.S. Ecosystems."



ery industry, botanical gardens, the USDA's Animal and Plant Health Inspection Service, and Randall and other weed experts. "We are focusing on voluntary screening of new introductions—an ounce of prevention is worth a pound of cure," says Craig Regelbrugger of the American Nursery & Landscape Association. "Our priority is plants that escape cultivation and alter the ecosystem. There is a genuine interest in the industry to do something."

For those alien plants that escape cultivation, ecologists call for rapid response teams to eradicate plants before they become established. As a start, eight states are establishing or expanding interagency teams to set weed prevention priorities and to help detect new weed infestations as soon as possible, says the USDA's Westbrooks. "The main idea is to get state and federal officials and private landowners to form partnerships to solve the invasive species problem," he says.

Perhaps the most difficult task will be controlling the alien plants that are already well-entrenched. Randall recommends focusing on highly valued areas such as biodiversity hotspots and prime farmland. Approaches include bio-control, herbicides, controlled burns, and grazing by goats. Once the weeds are under control, wild areas should be restored with native plants to keep alien species from reinvading and then monitored to make sure they remain weed-free.

To tackle the huge job of dealing with invasive alien species, the Florida Department of Environmental Protection's Schmitz and the University of Tennessee's Simberloff call for establishing a national center for invasive alien species. The center would be a clearinghouse for technical information about invasive species and would help coordinate state and federal efforts to control them.


Whatever the approach, an effective national strategy for invasive alien species will be expen-

sive. But acting now will be far cheaper than ignoring the problem, which keeps growing every day. "The big stumbling block will be Congress," says Schmitz. "Will they strengthen laws and authorize funding for additional programs?"

Brown of the Department of the Interior is optimistic. "I think that once they understand the importance of the issue, Congress will want to hear how to help agriculture and wild areas. It's going to take a bit of education for people to understand that we have to intervene because ecosystems have been so disturbed. We can't just turn our backs and hope for the best." Z

More information about invasive non-native species is available on The Nature Conservancy's website <<http://www.tnc.org>>.

Lists of species to avoid are available on these Exotic Pest Plant Council websites:  
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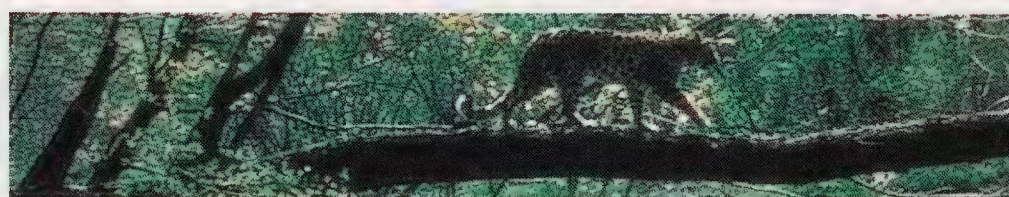


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# Sharing the

By Dale Miquelle



Igor Nikolaev, Han Xiaodong, and I stood on the ridge top, staring down at the fresh tracks left only that morning. A large male leopard, plodding through the crusty snow of early March, had crossed the ridge from left to right, disappearing into the drainage below. Our natural instinct was to follow the leopard's tracks to examine where he was heading. However, our Chinese guide motioned to Han, and stopped him from moving off the ridge.

Han explained to me, "I cannot track the leopard in that direction. I have no Russian visa."

An odd statement—unless you happen to be standing exactly on the border of Russia and China. To our right was Primorye Krai, Russia, and to our left was Jilin Province, China. It was a wild area, with few boundary markers, no fences, and only a faint trail to delineate the line. The oak forests that surrounded us on this spring-like day were so friendly and familiar to what my Russian colleagues and I knew from their side of the border, that it was hard to remember that we were standing on such a political hotspot, land

Institute of Biology and Soils in Vladivostok, Russia, could legally track this cat into Russian territory. Han and I contented ourselves with backtracking the animal into Chinese territory.

This survey, the first of its kind, was an international effort by Chinese and Russian specialists and one American to determine the distribution and status of Far Eastern leopards, and Amur, or Siberian, tigers, in Jilin Province, China. The fact that our interest lay more in the leopard, and not its "big brother," the Siberian tiger, is a lesson in conservation politics and education. How do you develop international and local public support

that the Japanese had once occupied, and where border skirmishes were once the norm between Russia and China. Only Igor Nikolaev, a Russian citizen and large-cat expert from the

for an animal nobody cares about, and hardly anyone knows about?

The Far Eastern leopard, *Panthera pardus orientalis*, is well known only to a handful of biologists and local hunters. Its large body size and thick winter coat, key adaptations to the northern habitats of Manchuria, Korea, and Far East Russia, distinguish this subspecies from other leopards. Seen in the winter, plodding through the snow, its thick coat shining, and long tail majestically swaggering under the Far Eastern sun, it is a sight few are prepared for, and no one soon forgets.

While anonymity can be a form of protection, for the Far Eastern leopard it has been a curse. Forced to live in the shadows of the more glamorous, charismatic Siberian tiger, with which it has overlapping ranges, the leopard has been ignored by conservationists, wildlife managers, and the local citizenry. While millions of dollars from the international conservation community have been invested in protection and study of the Siberian tiger since the 1992 opening of Russia, until recently the leopard has been virtually ignored. In Vladivostok, from which the last

ONLY 20 TO 30 FAR EASTERN, OR AMUR, LEOPARDS REMAIN IN THE WILD. UNTIL RECENTLY, ITS CONSERVATION NEEDS HAVE BEEN OVERSHADOWED BY EFFORTS TO SAVE THE BETTER RECOGNIZED SIBERIAN TIGER



*Spotlight*

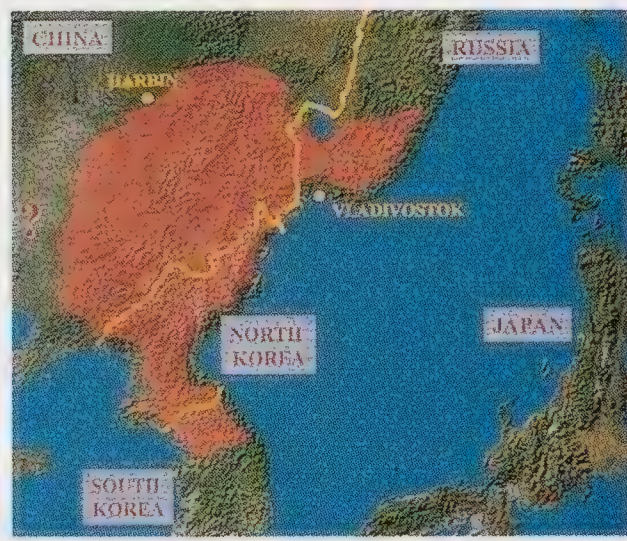




## LEOPARDS

remaining leopard habitat is clearly visible across the Amur Bay, everyone knows of the tiger, but most local citizens are surprised to hear that leopards still live in Russia, only 12 miles away.

Despite its anonymity, the woes of the Far Eastern leopard are many. It is severely threatened with extinction, much more so than the Siberian tiger. While a 1996 survey of the Siberian tiger suggested that 330 to 370 adults survived in Russia, a series of surveys on leopards has consistently pegged the number of remaining individuals at between 20 and 30. While the range of the tiger extends 600 miles north into Russian territory, the historic range of leopards, which are less tolerant of snow and cold, includes only the southern



THESE MAPS ILLUSTRATE ESTIMATES OF THE FAR EASTERN LEOPARD'S RANGE IN THE PAST AND PRESENT. THE LEOPARDS NOW OCCUPY ONLY A FRAGMENT OF THEIR FORMER RANGE.

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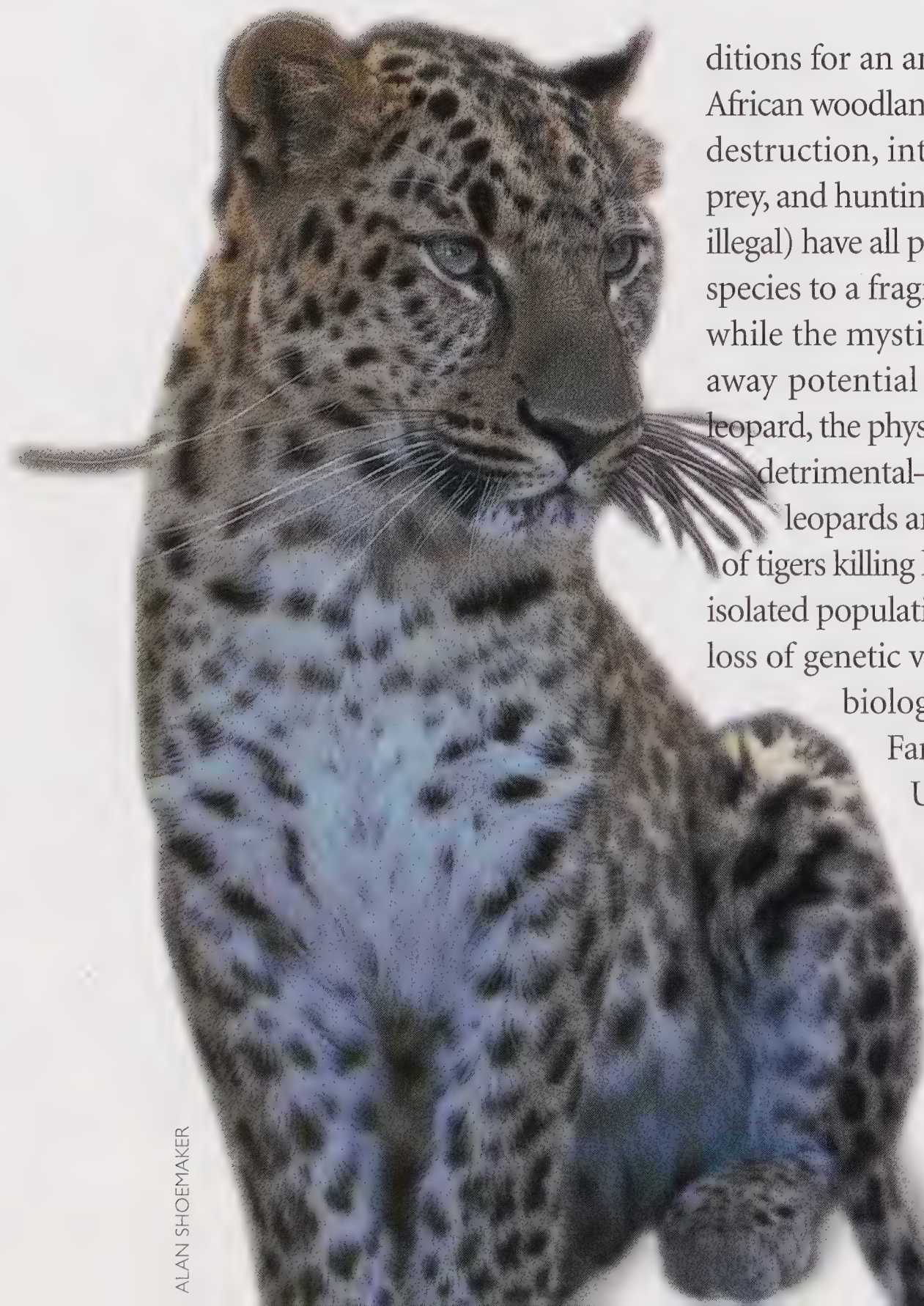
quarter of Primorye Krai. With much of its former habitat eliminated in China, the Far Eastern leopard's range has shrunk to one small fragment of habitat along the Chinese-Russian boundary. It no longer occurs in South Korea, and its status in North Korea is unknown.

The existing population along the Russian-Chinese border probably inhabits some of the least favorable habitat of its former range, where deep snows and long winters create poor con-

potential sponsors are far away in Europe and America and unlikely to visit the area, or appreciate the unique status of this northernmost leopard. One noted biologist and cat conservationist told me, when pressed for support of the Far Eastern leopard, "There are lots of leopards in the world." Of course, he was right, and that is another dilemma. Leopards are still abundant in Africa, where estimates suggest that more than 500,000 may still occur, and an unknown but also plentiful supply of leopards exists in Asia.

Of course, not all leopards are the same. Animals adapt to the specifics of their environment, and those adaptations are registered as variation in the genetic make-up of a species across its range. Rationalization that all members of a species are the same, if applied elsewhere, does not sit so well: For example, it would suggest eliminating support for the Florida panther (it is only a subspecies of the puma, well represented across western North America); or

Forced to live in the shadows of the more glamorous, charismatic Siberian tiger, the leopard has been ignored by conservationists, wildlife management specialists, and the local citizenry.



ALAN SHOEMAKER

ditions for an animal normally associated with African woodlands and the Asian tropics. Habitat destruction, intensive logging, elimination of prey, and hunting (both legal, and more recently, illegal) have all played a role in reducing this subspecies to a fragment of its former habitat. And while the mystical lure of the tiger has drawn away potential conservation support for the leopard, the physical presence of tigers can also be detrimental—throughout the Asian range of leopards and tigers, there are many records of tigers killing leopards. Now, with such a small, isolated population, the threat of inbreeding and loss of genetic variation has lead many Russian biologists to fear that the days of the Far Eastern leopard are numbered. Unfortunately, the zoos of the world, usually the last hope for endangered species, hold a meager number of pure, Far Eastern leopards.

Despite its perilous status, it has been exceedingly difficult to raise interest in this cat. Most

eliminating conservation efforts for the Siberian tiger (just a subspecies of an animal better represented in India). Across the range of any species, individuals at the outermost fringes display a unique set of adaptations, and if protected, will increase the genetic diversity across the species range more so than subspecies near the center of distribution. The Far Eastern leopard is a shining example. A recent Friends of the National Zoo-funded analysis of leopard genetics by Sriyanie Miththapala and John Seidensticker of the National Zoo, found that, while formerly some 34 subspecies of leopards were recognized, only eight can be clearly defined using molecular and morphological analyses. Of these, the Far Eastern leopard stands out from all the others, related closely only to its nearest neighbor, the North Chinese leopard (*P. p. japonensis*), which may be extinct in the wild.

The Far Eastern leopard also serves an important function as an indicator of ecosystem health in the region. Any environmental impact can have a "ripple" effect that magnifies as it goes up the food chain. The leopard, at the top of the



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chain, is a very adaptable species, capable of surviving in a variety of conditions throughout African and Asia. But here, at its northern limits, cold temperatures, deep snow, and low prey densities pose special challenges to survival, and changes in land-use practices and development schemes create additional burdens that can have serious consequences.

Far Eastern leopard habitat has been under intense human pressure for more than a century, and the leopard serves as an important measuring rod to judge the integrity of the remaining habitat. Korean and Chinese influence has waxed and waned in this region over time, but in the previous century (until 1920), large numbers of both nationalities moved into "Ussuriland," a region noted for its rich biodiversity. Here Southeast Asian, temperate, Himalayan, and boreal bioregions merge, creating a wealth of species in a unique combination found nowhere else: sable, moose, wolverine, and brown bears from the north, yellow-throated marten, black bears, and musk deer from the Himalaya, dholes (small canids), sika deer, tigers, and leopards from the south, and red deer, wild boar, and roe deer from temperate regions. All these species were readily exploited by new inhabitants for furs, meat, and traditional Asian medicines.

Russians started moving into the region in the second half of last century, creating yet another wave of forest clearing and resource exploitation. Yankovski's well-known book, *A Half-century of Tiger Hunting*, which describes his exploits in the first half of this century, includes a photo of himself with two leopards—the result of a day's hunt—hanging in the background. The extent of overutilization led V. K. Arseniev, a famous Russian geographer and explorer, to mourn, "On every side one sees nothing but robbery and exploitation. In the not distant future this land of Ussuria, so rich in animal life and forest, will be turned into a desert." It was only 1906. Yet to come were the Russian revolution of 1917, when bands of both red and white Russians, heavily armed, roamed the forests, shooting wildlife and each other; the Japanese invasion of China, moving directly through the heart of leopard habitat; the Russian battles with the Japanese during World

War II, and then its border skirmishes with China; and finally the Korean conflict, which destroyed wildlife populations throughout the Korean peninsula. Among all this upheaval, Russian and Chinese settlers arrived in larger numbers on their respective sides of the border. On the Russian side, annual burning has, over the course of a century, destroyed forest habitats, converting much of southwest Primorye, once

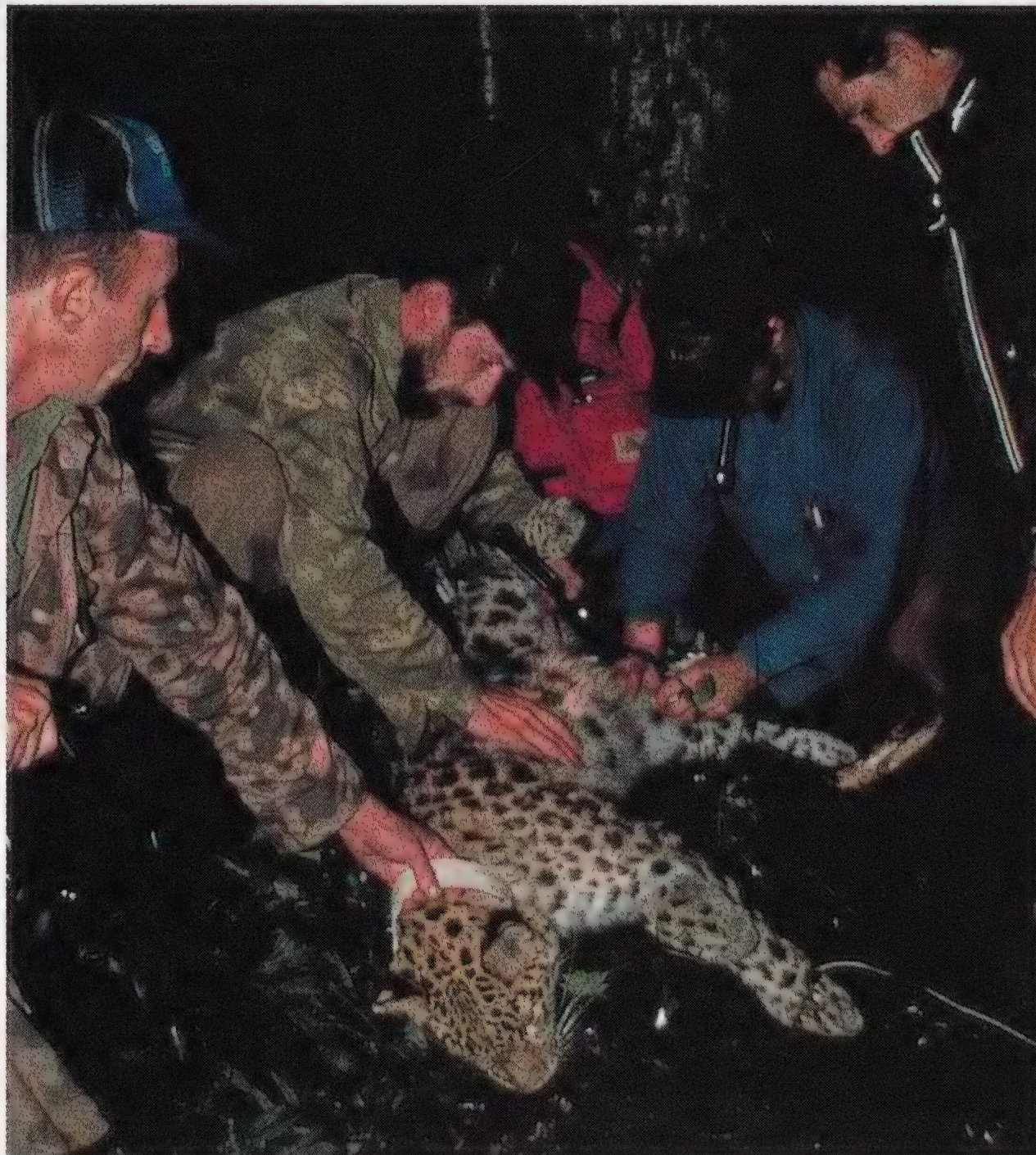
ards, because development on both sides will be more likely.

Despite the concerns of a few local scientists, virtually nothing was being done to protect the leopard, and its prospects looked bleak. Then, in 1993, the Hornocker Wildlife Institute, in concert with the Russian Academy of Sciences Institute of Biology and Soils and Institute of Geography, launched a Far Eastern leopard project. The goal was to radio-collar leopards in remaining Russian habitat to obtain information to help develop a conservation strategy. This collaborative effort was the first attempt to focus attention on the plight of this cat, and its main successes were the capture of six leopards, and an increasing international awareness of the status of this subspecies. However, the project suffered continually from a lack of sponsorship, and disinterest and lack of commitment from key components of the Russian infrastructure.

Since 1992, I had watched activities surrounding the leopard from afar, engaged in my own study of Siberian tigers to the north. However, in 1995, I agonized before agreeing to leave my field work and take a desk job as biodiversity manager for a U.S. Agency for International Development (USAID), Russian Far East "Environmental Policy and Technology" (EPT) Sustainable

Natural Resource Management Project. Although it was difficult to leave my research, here was a chance to funnel funds into conservation projects that could have major impacts. Among many other projects, I wanted to make the leopard an important component of our agenda. We allocated funds for support of key protected areas, and pumped new life into anti-poaching efforts. With the gazetting of a new leopard refuge by the Primorye Krai Administration (Borisovkoe Plateau Zakaznik), the EPT Project provided funds for infrastructure support.

Thus there had been a few successes, but it was a workshop we convened that was the catalyst for change. With support from USAID, the World Wildlife Fund and the EPT Project brought together all concerned parties in Russia, as well as internationally recognized large-cat



SCIENTISTS FASTEN A RADIO COLLAR TO A LEOPARD FOR TRACKING PURPOSES AND TAKE BLOOD AND FUR SAMPLES FOR ANALYSIS.

leopard habitat, into grasslands like those of eastern Montana. On the Chinese side, nearly all suitable terrain has been converted to rice or soy fields.

The leopard has somehow hung on, yet even in Russia, the stronghold of leopards for the last 50 years, things are getting worse. Development of the region north of Vladivostok in the first half of this century split the remaining population into three parts, and in the past 25 years, two of these subpopulations have apparently gone extinct. The last remains along the Chinese border, a haven for wildlife primarily because the historically cool relations and border disputes between the two countries have prevented development. Ironically, a warming of relations between China and Russia and consequent greater political stability may be an ill omen for leopard

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conservationists, to hammer out a plan to save the Far Eastern leopard. We spent a week in October 1996 in Vladivostok, debating, and sometimes vociferously arguing, about the pros and cons of various proposals for research, reintroduction efforts, zoo breeding, land-use planning, genetics, protected area management, legislation, and environmental education. Exhausted but delighted at the end of that week, I held up a document at our final banquet that was a consensus of scientists, administrators, conservationists, and educators about what needed to be done. At last, there was a blueprint for action.

Many such documents end up gathering dust on bookshelves, and it was our fear that such would be the case for this one. Slowly, however, various components of the plan are being put into action. Tigris, a Dutch conservation group, is sponsoring an anti-poaching team to focus specifically on protecting the leopard and its habitat. The Hornocker Wildlife Institute has co-sponsored a Russian-trained geneticist, Olga Uphyrkina, to spend a year at the National Institutes of Health genetics laboratory in Frederick, Maryland, under the supervision of Stephen O'Brien, noted authority on cat genetics, to assess the status of the Far Eastern leopard in zoos and in the wild to determine if inbreeding is a problem. A tri-national Ussuri


Basin Planning Team proposed creation of an international "Big Cat" park that would increase the level of protection in Borisovkoe Plateau Zakaznik, and protect key habitat on the Chinese side.

But dilemmas remained. The Hornocker leopard research project, and before that the intensive research efforts of Russian biologists Dimitry Pikunov and Victor Korkisko, had done a good job of delineating the habits and habitat of Far Eastern leopards in Russia. But virtually nothing was known about its status in China or Korea. Although representatives of Jilin Wildlife Association, Jiang Jinsong and Xingjia Yang, had attended our workshop in Vladivostok, and we had discussed how useful a survey in China might be, how to implement it seemed a mystery to us. North Korea remained a black box, especially for me, an American, but also for my Russian counterparts.

Now, yet another development project has provided both a threat, and an opportunity. The United Nations Development Programme-sponsored "Tumen River Project" is a large-scale development plan to create a free economic zone at the tri-border region of China, Russia, and North Korea. This plan would give China access to the Sea of Japan as a shipping route, increase economic activity in Russia tremendously, and provide a needed boost to an im-

poverished North Korea. Yet the proposed development corridor would slice through the heart of leopard country, potentially eliminating any existing or potential ecological corridors among the three countries, and further fragmenting leopard habitat. UNDP has been very sensitive to potential environmental impacts, so when we proposed a survey of tigers and leopards across the tri-country area, the idea was quickly picked up by Ian Davies, the Tumen Secretariat responsible for overseeing this project. We mapped out a plan with Dimitry Pikunov, a bull of a man who has spent much of his life studying and vigorously speaking-out for protection of the Far Eastern leopard. With additional support from the Wildlife Conservation Society, and contact finally made with Yang Shihe and Jiang Jinsong of the Jilin Wildlife Protection Association (a branch of the Jilin Ministry of Forestry), we were set to go.


The first phase of this work, completed last winter, was conducted in Jilin Province, and it was here that Igor Nikolaev, Han Xiaodong, and I met the leopard tracks. Unfortunately, such meetings were rarer than we had hoped. Our results, while not conclusive, indicated that perhaps four to seven leopards occur within Jilin. Nearly all of them are in the county closest to the Russian border, indicating that many of these animals may spend only part of their time in



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# The concept of a united tri-country management plan for Far Eastern leopards is taking hold.



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COLD TEMPERATURES, DEEP SNOW, AND LOW PREY DENSITIES POSE CHALLENGES TO SURVIVAL FOR FAR EASTERN LEOPARDS—NOT TO MENTION THE POLITICS OF WILDLIFE CONSERVATION.

China. As we ourselves saw, animals are going back and forth across the border, even if people are not. The reason few leopards now inhabit this region appears to be the lack of prey. And the reason for the lack of prey appears to be

an abundance of wire snares, set by local people to supplement their meager income with fresh meat. Ten percent of all snares found had killed either sika or roe deer. Making a crude assessment of the density of snares, we estimated that as many as 3,000 deer are being killed annually in the 1,200 square miles of forests in the county closest to Russia, which offers the greatest opportunity for leopard recovery.

Despite our disappointment at the small number of cats and the low prey densities, there was considerable reason for optimism. To our surprise there are extensive tracts of well managed forests that could provide excellent habitat for leopards. Just as important is the attitude of the people in Jilin Wildlife Protection Association: Yang Shihe and Jiang Jinsong, among others, are committed to improving conditions for wildlife in China. Before we had even finished our survey, they were in the process of having a decree passed to require all Forest Service workers to remove snares from their forest districts.

If our plans hold, Pikunov, Nikolaev, and I, as well as other Russian specialists, will travel to the northernmost province of China, Heilongjiang, in the winter of 1999 to assess lands on the

Chinese side of the proposed Big Cat International Park. Already, with support from the Wildlife Conservation Society, Pikunov and Nikolaev went to North Korea to meet officials, see the habitat, and lay plans for a more intensive survey. And from our survey of Jilin, we recognize the potential for a key ecological corridor: At one point along the Tumen River fewer than ten miles of mountainous habitat in China separates Russia and North Korea. No barriers would prevent a leopard from traveling from Russia to North Korea in a single night. Unthinkable just a few years ago, the concept of a united tri-country management plan for Far Eastern leopards is taking hold.

Not long after our conference in Vladivostok, Dimitry Pikunov gathered some of us in his home for dinner. Dima poured vodka into shot glasses as we sat down to eat. "I want to toast to our leopard," he started out, and then began to reminisce. "When I was young, I walked all over southern Ussuriland, and especially the western border regions with China. These were one of my favorite hunting areas. In those days, it was not uncommon for me to see tracks of the dhole, and though we knew it was rare in Russia, it never occurred

to me that we might lose this species. But the dhole disappeared from the Russian Far East in my lifetime, and no one said a word, no one spoke out to warn of the impending extinction."

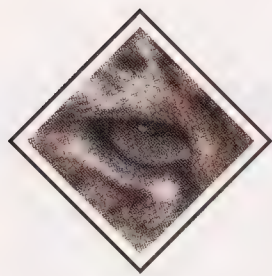
He paused for a moment, absorb-

ing that loss, before continuing. "I have always regretted that I stood by and did nothing, that we all stood by and did nothing, and watched the dhole go extinct when there was still time to do something, to make a difference. We can't let that happen a second time. So let's drink to our commitment to the leopard, to ensure that the leopard does not meet the same fate as the dhole. Let's drink to our Far Eastern leopard." We tipped back our glasses, hopeful our efforts to save this magnificent large cat would succeed. Z

**Dale Miquelle** is regional coordinator in the Russian Far East for the Hornocker Wildlife Institute and associate scientist for the Wildlife Conservation Society.

If you would like to help, or would like more information, contact the Hornocker Wildlife Institute: P.O. Box 3246, University Station, University of Idaho, Moscow, ID 83843; telephone: 208-885-6871; email: [hwi@uidaho.edu](mailto:hwi@uidaho.edu); website at: [www.uidaho.edu/rsrch/hwi](http://www.uidaho.edu/rsrch/hwi).





## BOOKS, NATURALLY

*From Botswana to the Bering Sea: My Thirty Years with National Geographic.* 1998. Thomas Canby. Island Press, Washington, D.C. 288 pp. Hardbound, \$24.95.

Thomas Canby's memoir tells the inside story of getting the story for *National Geographic*. Canby worked as a writer and science editor for the magazine with the trademark yellow border for 31 years. In that time he traveled to

the ends of the Earth to research and write about the first Americans, El Niño, the Soviet space program, and other natural history and technical topics. While the memoir traces the development of writer and man, it also reveals that Canby never lost his boyish curiosity or became jaded the way career journalists sometimes do. He reiterates throughout the book, whether discussing the perks or drawbacks of being a Geographic man, that he believes he had the best job in the

world. It's hard not to agree.

"Life can be almost too good when you're on assignment for *National Geographic*," he writes, "hosts figuratively rolled out the red carpet, and doors swung open before me." That, coupled with the "travel wherever you must to get the story" editorial attitude, can make anyone, writer or not, envious.

The book opens with Canby and Geographic photographer Steve Raymer in the sweltering office of a Nigerian bureaucrat. Waving a letter from the American consulate, the pair try to persuade the official to grant them free access within the country to research and

shoot an article about famine. Working for the world-renowned publication, the young Canby assumes name recognition will serve as his passport through the country. As we find out, it usually does. But this official is one of a handful of people in the world who has never heard of *National Geographic*. A decision was made, leaving Canby and Raymer "deflated."

The famine-stricken Saharan wasteland is one of several remote places Canby takes his readers. In one chapter we slog through the oil-saturated Kuwait desert and meet the men who worked tirelessly to cap the geysers ignited by Saddam Hussein's troops. We learn the politics behind the cleanup and how these acts of ecoterrorism affected the environment. We also trek around the world to Hawaii, India, Italy, Germany, and New York, among other places, for an article about rats. Famished after a long day researching this story in Philippine rice paddies, Canby sets aside American taboos and joins his hosts for a feast of deep-fried rats.

Maintaining a diplomat's tact while sampling exotic foods, coping with loneliness, and surviving on little sleep to get the story is part of the challenge of a Geographic assignment. So too is danger. Canby supplies a list of illnesses that have afflicted writers—malaria, frostbite, diver's bends, and "irksome jungle parasites that lodge in the belly or beneath the skin and defy medical remedies." Fortunately, as former editor Bill Garrett pointed out, the magazine's staff has been extremely lucky. To date only one writer has been killed on assignment despite the life-threatening risks writers may face while in the field.

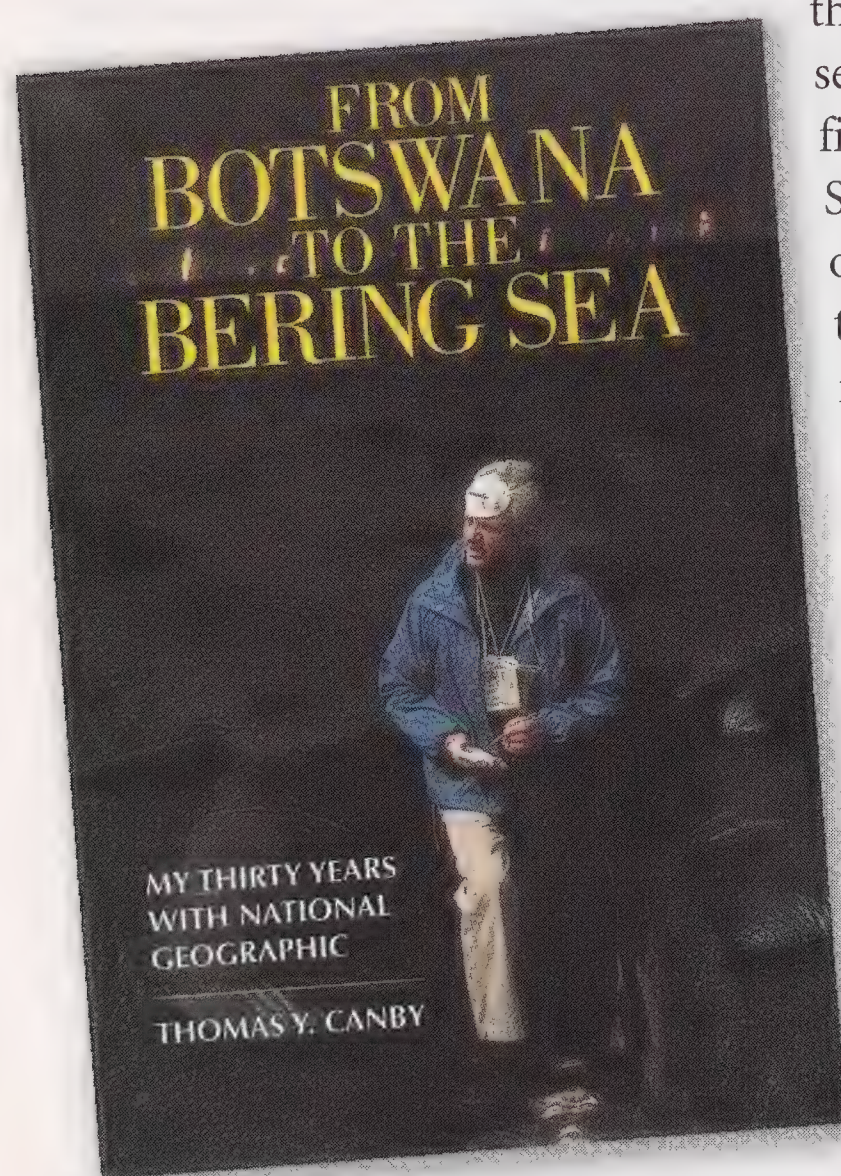
On this literary journey Canby also takes readers to the white mar-

ble monolith on 17<sup>th</sup> Street, where *National Geographic*'s editorial offices are located. Canby walks us through the gestation of an article, from concept to publication. We see how writers are assigned, how trips to remote destinations are planned, and about the bonding with fellow journalists that comes from sharing hardship and adventure. Along with the good relationships, Canby weaves in the "cataclysmic falling out" between Gil Grosvenor, whose family has dominated the Society for 110 years, and the highly regarded Garrett. As if begging to be asked, Canby also offers Garrett's explanation for the magazine's notorious photographs of bare-breasted indigenous women that kept generations of youth waiting for each month's issue.

For nearly a century, *National Geographic* writers and photographers were guided by scientific and geographic quests and enjoyed a "stay out in the field as long as you need" editorial mandate—some writers and photographers were given years to complete an assignment. In that time *National Geographic* became a cultural icon and part of the world's collective consciousness.

While the Society's mission hasn't changed, the administration has. Today's *National Geographic* must be as concerned with maintaining the editorial integrity we expect as it is with the bottom line. Budgets for lavish adventures and expense accounts have been cut drastically, understandably to the dismay of longtime staff. *From Botswana to the Bering Sea* offers a glimpse of working for *National Geographic* back in the days when editors, not businessmen, had the final word.

—Robert Moll





# MATTHEW HILLIER

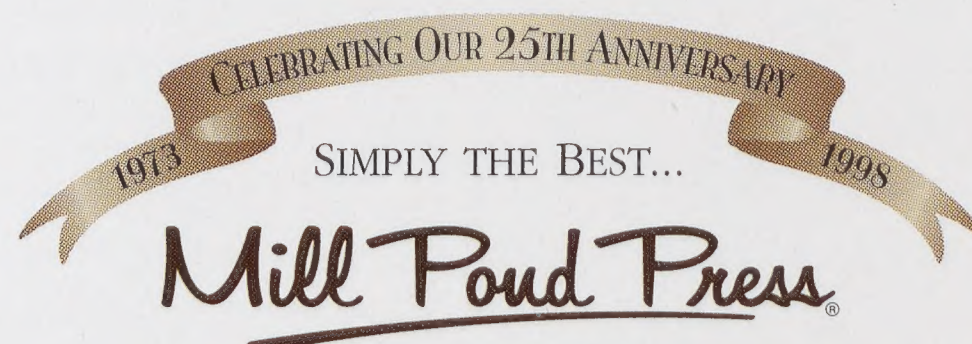
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## BIOALMANAC

### What's in a Name

With its bat-like ears, bony fingers, and huge rodent-like incisors, the aye-aye is unlike any other lemur. In fact, early zoologists found the weird-looking prosimian so confusing that they first classified it as a squirrel, and gave it eight different generic names before settling on *Daubentonia madagascariensis*, in honor of 18<sup>th</sup>-century French naturalist Louis Jean Marie Daubenton and the aye-aye's home country of Madagascar. The aye-aye is now known to be a primate, but such an unusual one that it is classified in its own family, Daubentoniidae. We also now know that its odd features help it forage for food—it listens for insect larvae in decaying branches with its large ears, bites through the wood with its sharp teeth, and pulls out the larvae with its long, flexible third finger.

There are several theories about the origin of this animal's common name. One is that it's based on the sound the aye-aye makes. Another is that the name comes from the cries of alarm ("Aiee! Aiee!") people gave when they saw the creature, which many Malagasy still kill on sight, believing it to be a harbinger of death. Yet another theory holds that the name derives from the Malagasy expression "hey-hey" meaning "I don't know," possibly indicating that people were reluctant to say the name of an animal thought to bring bad luck. The aye-aye is highly endangered, due to habitat loss and human aggression.

—Emily Schuster

### Good News

When most people catch a five-and-one-half-inch fish, it's nothing to brag about. But the little fish that scientists from the U.S. Geological Survey pulled out of the depths of Lake Ontario last April was big news by anyone's standards. The adult female was the first deepwater sculpin (*Myoxocephalus thompsoni*)—a once-abundant native species—to be caught in the U.S. waters of the lake since 1942. The fish are rare on the Canadian side of the lake, too—only six have been found since 1972.

Deepwater sculpins live at the bottom of the lake, but their larvae occupy shallow water. Unfortunately, so does the alewife (*Alosa pseudoharengus*), a non-native fish that probably invaded the lake through the Erie Canal and preys on many native fish larvae. Recently, though, introduced predators like trout and salmon have decreased the alewife's numbers, and new colonies of zebra and quagga mussels seem to have forced the alewife away from the larvae into deeper waters. The alewife's decline, along with efforts by the U.S. and Canadian governments to clean up the lake, have led to an increase in native fish populations, including the burbot, the emerald shiner, and, of course, the deepwater sculpin.

### Bad News

A fungus never before known to infect vertebrates is now thought to be at least partially responsible for the worldwide decline of amphibian populations. National Zoo veterinary pathologists were instrumental in identifying the fungus as a chytrid (class Chytridiomycetes). The chytrid

may suffocate amphibians, which breathe through their skins, by coating their undersides and legs.

Most likely, environmental factors such as ultraviolet radiation, pollution, and habitat destruction are affecting the amphibians' immune systems and allowing the chytrid to grow to dangerous levels. Many cases of the fungus have been reported in zoos and in wild amphibians in Australia, Panama, and the U.S.

A standard antifungal treatment could probably cure infected amphibians in zoos, but its use is not practical in the wild. According to National Zoo veterinary pathologist Don Nichols, the only way to save wild amphibians would probably be to correct the environmental problems that are damaging their immune systems.

—from *New Scientist*  
June 27, 1998

### The Area Scene

Maryland was one of the last states in the continental U.S. to become home to coyotes. Eastern coyotes first arrived in Maryland more than a decade ago and have now been sighted in virtually every county in the state, according to Robert Colona, Furbearer Project Biologist at the Maryland Department of Natural Resources.

Although coyotes are not new to the area, they were not officially recognized as a species in the state until a few years ago. This legislation, which allows coyotes to be protected or managed as necessary, was recently renewed for another two years.

The adaptable coyotes consume everything from sheep to blueberries, reproduce quickly, and can live in pairs or packs, depending on what gives them the

greater hunting advantage.

While coyotes can be helpful by keeping populations of woodchucks and other small animals in check, they may hurt other predators, such as red foxes, through competition and aggression. Coyotes live well in suburban areas and can prey on household pets, such as cats and small dogs. To protect your pets, Colona suggests that you feed them inside and do not allow them to roam free, even in the daytime.

### May Day for Mayflies

Many adult mayflies are laying their eggs on roads rather than in streams, Hungarian researchers say. Water-dwelling insects often identify suitable places to lay their eggs by searching for the horizontally polarized light that reflects off water, and light reflecting off asphalt is also polarized in a horizontal plane. Warm air and a lack of vegetation over roads may also make them more appealing egg-laying sites than streams. The eggs of mistaking mayflies dry up and die when laid on these roads.

The unfortunate choice of breeding grounds could be a serious threat to mayfly populations in any region where mayflies emerge near asphalt roads, according to György Kriska and Gábor Horváth of Eötvös University in Budapest. A large decrease in mayflies might also affect life in streams, where fish eat mayflies and the insects' carcasses and egg cases add carbon to the ecosystem. The problem could be alleviated by making asphalt roads rougher in texture to help depolarize the light.

—from *New Scientist*  
July 25, 1998



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Value up to \$7.99. Offer excludes "Awesome Appetizer Adventure." One Complimentary Appetizer per table, per visit. Offer valid thru December 31, 1998, at the Tysons Corner Center location only.

ZM